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ABSTRACT

A manufacturing curriculum for secondary vocational programs was designed to bridge the gap between grades 9-10 level courses and the community college-level curriculum of the Illinois Plan for Industrial Education. During the project, a literature review of manufacturing curriculum materials was conducted, a manufacturing conceptual framework was constructed by an industrial task force, and a curriculum content outline was produced. Content includes the following: occupational safety and health; business economics; measurements, drawing interpretation, layout, and inspection; product and process control; quality; and marketing and promoting manufacturing skills (job search methods). The curriculum format was based on a survey of a random sample of industrial arts teachers. An article on the project was submitted to a scholarly journal. (Appendixes, which make up most of the document, include the following: (1) a brief summary of the literature search; (2) draft curriculum goals, outlines, and objectives; (3) summary of manufacturing curriculum questionnaires; (4) and a manufacturing curriculum activity plan format.) (KC)

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FUNDING AGREEMENT NUMBER: PT-I0726

MANUFACTURING CURRICULUM GRANT

FINAL REPORT

SUBMITTED BY:

JULE DEE SCARBOROUGH

DEPARTMENT OF TECHNOLOGY

NORTHERN ILLINOIS UNIVERSITY

DEKALB, ILLINOIS

JULY 30, 1989

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2a.

Official Project Title: Manufacturing Curriculum

Department of Adult, Vocational and Technical Education Funding Agreement Number: PT-I0726

Project Director: Jule Dee Scarborough

Funded Agency: Northern Illinois University Department of Technology

Location of Funded Agency: DeKalb, Illinois

Time Period Covered: 7/1/88-6/30/89

Goal of the Project and Its Relevancy to Vocational Education:

The goal of this project is to develop a manufacturing curriculum for the secondary preparation vocational education program level. This curriculum should "bridge the gap" between the Orientation, grades 9-10 level systems courses and the community college level, equipment-oriented, computer-aided manufacturing curriculum of the Illinois Plan for Industrial Education.

The relevance of the project to vocational education in Illinois is that it will focus on industrial manufacturing subject matter not traditionally addressed in curriculum materials or taught in industrial vocational programs. Materials processing is certainly part of production, but production is only one aspect of manufacturing; therefore, the industrial team has been asked to identify concepts and tasks across categories such as marketing, research and development, engineering, management, quality control, production scheduling, training, and others.

Major Accomplishments of the Project:

The Project's first year has resulted in the following deliverables:

1. National literature review for manufacturing curriculum materials.

2. Manufacturing conceptual framework in which concepts were identified by an industrial task force.

4. Curriculum content outline from which to develop activities.

Products Delivered:

ISBE/DAVTE Final Report FY 1988-89.

2b.

Expenditure of Funds:

There is no discrepancy between the original funding agreement and actual expenditures.

2c.

Paid Participants in Activity:

The following individuals were paid participants FY 1988-89:

Brent Steel, instructor, Elgin Community College, Manufacturing; Mike Sons, teacher, Rolling Meadows High School, Manufacturing; Ernie Johnson, teacher, Winnebago High School, Industrial Education; Roger Cliffe, Professor, NIU, Manufacturing; Jule Scarborough, Professor, Professor, NIU, Manufacturing; Barbara Sherman, secretary; Ron Spaulding, graduate assistant.

2d.

Resource Listing:

The following resources were purchased:

Illinois grant products
Illinois Manufacturers Directory
Computer Integrated Manufacturing Manual
Exploring Manufacturing Technology Teacher's Guide
Word Perfect software

Human Resources:

ISBE/DAVTE consultants: Jerry O'Hare, John Lopatz, Chuck Windhorst, Ron Engstrom; others: Mike Elliott, ICCB; Gordon Ropp, ICOVE; Bob Beck, ICOVE; Mrs. Satchwell, UI.

2e.

Major Accomplishments and Significant Findings of the Project:

The following objectives were accomplished during the first year of the project, 1988-89:

1. Obtained the ISBE/DAVTE Manufacturing Occupations Cluster task lists and IPIE Revised Curriculum Guides. These were reviewed so that project staff developed an understanding of what has already been accomplished.

2. Identified a statewide industrial manufacturing team for various types of continuous input throughout the project. The industrial team is identified below:

   Chrysler - Winn Geroux
   Caterpillar - Jerry Wright
   Knapheide - Steve Meckic
   Sundstrand -
   Honeywell - Chester Furmanski
   Allsteel - Phillip Jeska
   Motorola - Tom Fordonski - Claire Hyman
   Echlin - Greg Arendall
   Shawnee Meat Packers - William Pfeffer
   National Alliance of Business - Vince

3. Conducted a national literature search for manufacturing occupations-related curriculum materials. See Appendix A.

4. Identified a statewide vocational manufacturing-related secondary teacher field-test team. The field-test team schools have been identified; ISBE/DAVTE is in the process of contacting local administrators.

5. Identified curriculum writers for development activities. The writers are Brent Steel, Mike Sons, Roger Cliffe, and Ernie Johnson.

6. Identified the manufacturing process-specific and the generic concepts to be included in the curriculum product. See Appendix B for this information. Also see Appendix C.

7. Identified technical activities to support the conceptual framework. The teachers have begun this activity; they will complete this activity in 1989-90.

8. Surveyed a statewide random sample of teachers to determine a preferred curriculum format. See Appendix D.

9. Developed a teacher-preferred curriculum format based upon survey information. See Appendix D.

10. Determine learner outcomes and align them to appropriate state goals for learning. This objective has been begun in 1988-89 and will be completed in the 1989-90 project year.

e2.

Product Abstract:

There is no product FY 1988-89. The draft product outline is located in Appendix B.

Major Dissemination Activities:

Submitted teacher-preferred curriculum format to the Technology Teacher journal, an ITEA publication.

Staff Development:

There were no staff development activities during the project's first year.

Publicity:

There was no publicity during the project's first year.

f.

Problems:

There were no problems in FY 1988-89.

Summations of any Evaluation Data Collection:

All evaluations were positive. The industrial task force communicated that the meeting had been positive for them even though they were generating information for the project. The occupational consultants indicated that they were satisfied with the teacher writing team. The literature search information was presented for review by ISBE/DAVTE; the reviewer was satisfied. See Appendix A for this review. The writer's team felt satisfied that their orientation was appropriately accomplished. The curriculum format was determined by a random sampling of the industrial teachers statewide. Appendix D shows the results. ISBE/DAVTE approved the format. Thus, all evaluations were executed and positive. More formal evaluations are scheduled to take place during the 1989-90 field-testing procedures.

h.

Statement of Impact:

Because this was the first year of a three-year development grant, the impact was minimal, but important. It is very important that industry realize vocational educators cannot prepare employees appropriately or adequately through the educational process without their input. The industrial task force represented major industries in Illinois. It was apparent the industrial representatives felt positive in regard to our "asking" them what the curricular content should consist of conceptually, as well as in application. They also indicated that they are impressed that we are committed to delivering a product at the end of the grant that will not, through normal development processes, change such that their content suggestions will not be recognized.

i.

Conclusions and Recommendations:

The project accomplished the first year's objectives. It is recommended that Year 2 funding is appropriate to deliver and field-test the curriculum draft.

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APPENDIX A

LITERATURE SEARCH FOR MANUFACTURING CURRICULUM PROJECT

Introduction

The literature search fulfills objective 3 of the Manufacturing Curriculum Project (Time Sequence Chart, Fiscal Year 1988-89, PT-I0726). The purpose of this search is to identify manufacturing curriculum materials that could reduce the cost of curriculum development or make curriculum development easier. The literature search can also validate our findings, make research easier, and identify topics or information that may have been overlooked.

Procedure

The literature search for the Manufacturing Curriculum began with computer searches in ERIC, RIE, CIJE, AND RIVE. The searches used the following descriptors:

Manufacturing	Curriculum
Curriculum Guides	Curriculum Development
Curriculum Research	Instructional Materials
Educational Resource	

The materials identified by the computer searches were examined. Any title related to the Manufacturing Curriculum was then evaluated using the ERIC Abstract.

In addition to the computer search, a similar search was done using the National Network for Curriculum Coordination in Vocational and Technical Education. The findings of these were also examined.

Finally, numerous manufacturing materials were collected for examination by the Illinois Vocational Curriculum Clearinghouse. All of these materials were examined carefully and returned.

Discussion

In evaluating the materials from the searches, it was found that many of these materials were similar: those in the Illinois Plan for Industrial Technology Education - Orientation to Industrial Technologies, grades 9-10. The curriculum for manufacturing should be at the 11-12 grade level.

Some materials were identified as useful in whole or in part. The titles of these materials are listed at the end of this report. These same materials were discussed at a meeting between members of the curriculum writing team and representatives of the Department of Adult, Vocational, and Technical Education, State of Illinois, on April 10, 1989.

1. Living with Technology, Hacker & Barmen, Delmar Technology Series.

2. Manufacturing (2nd ed.), Fales et al., Bennett & McKnight.

3. Manufacturing Technology, Barnes, Extension, Instruction and Materials Center, University of Texas at Austin.

4. Manufacturing Systems, Glock et al., Extension, Instruction and Materials Center, University of Texas at Austin.

5. Technology Systems, Bridge et al., Extension, Instruction and Materials Center, University of Texas at Austin.

6. Exploring Manufacturing Technology, J. Iley, Mid America Vocational Curriculum Consortium, Stillwater, OK.

Manufacturing Curriculum Areas	Sources That Address Manufacturing Topics
Technical Skills:	
Print Reading	2, 5
Automation	2
Quality	2
Measuring	3
Gage Reading	
JIT	
Production Systems	1, 5, 6
Processing Materials	1, 2, 3, 4, 6
Manufacturing in Future	1, 2, 3
Research & Development	2, 6
Safety	2, 3, 4

Manufacturing Curriculum Areas	Sources That Address Manufacturing Topics
Interpersonal Skills:	
Decision Making/Problem Solving	4
Honesty	
Ethics	
Teamwork	
Cross Cultural Relationships	4
Vocational Ethics	
Comm. Bus. Mtg.	3
Computer Skills:	
Keyboard Skills	5, 1
CAD	3, 1
CAM	3, 1
CNC	3, 1
Desk Top Publishing	5
The Workplace:	
Role in Industry	3, 4
Oral/Written Instructions	
Listening Skills	4
Following Directions	
Time-Deadline Schedule/ Punctuality	1
Group Participation	
Follow Through	
Role of Business	3, 6
Advancement	3

APPENDIX B

DRAFT CURRICULUM GOALS, OUTLINES, AND/OR OBJECTIVES

Unit Goals - Occupational Safety and Health

Upon the successful completion of this unit, the learner will be able to:

1. Recognize unsafe machine practices related to forming, separating, and combining processes.
2. Demonstrate a safe attitude in the manufacturing environment.
3. Trace the history of occupational safety and health in the United States, citing important events and trends.
4. Name and describe safety and health-related legislation or regulatory agencies that control industrial operations in the United States.
5. List the real and hidden costs of an accident and discuss their impact on profit and morale.
6. Describe the elements of an accident investigation and discuss the purpose and significance of conducting an accident investigation.
7. Identify and evaluate careers related to occupational safety and health.
8. Define product liability and discuss how it differs from occupational safety and health.
9. Explain the manufacturer's responsibility for product liability and discuss the consequences of a poorly made or designed product.
10. Apply basic communication skills to accident reports, safety checks, and safety inspections.
11. Evaluate tools, materials, jigs, and fixtures for safety and fitness. Make recommendations to eliminate unsafe conditions.

12. Describe ways in which manufacturing impacts on our environment. Make recommendations for improving the environment.

13. Use basic communication skills to develop safety rules/guidelines for a machine, power tool, or hand tool.

14. Review accident statistics and identify trends in industrial accident prevention.

15. List common resources that can be consulted to solve industrial safety and health-related problems.

16. Describe trends in occupational health related to the control of industrial diseases and disorders. Make extrapolations concerning occupational health in the next decade.

Unit Outline - Occupational Safety and Health

I. Accident Statistics

A. Learners work with accident terms and accident statistics

B. Learners interpret data by developing pie charts and bar graphs of the data

C. Learners define terms related to accident statistics

D. Learners make predictions/extrapolations based on today's data

II. Accident Safety and Training

A. Applicable machine safety rules are learned

B. Students pass a safety test developed by the teacher

C. Students analyze and research safety rules to develop a video script related to accident safety

D. Teacher reviews and approves the script

E. Students produce a 5-minute safety video

III. Accident Investigation

A. Students examine accident investigation forms and discuss the types of information found on them

B. Teacher provides samples data concerning an accident

C. Students fill out an accident form using the data

D. Students divide into groups and develop accident scenarios

E. Students exchange accident scenarios and fill out accident forms

F. Students analyze the accident reports and make recommendations to eliminate the hazards

IV. Accident Record Keeping

A. Students become acquainted with the Occupational Safety and Health Act (OSHA)

B. Students learn terminology related to OSHA record keeping such lost-time accident

C. Students are given OSHA record keeping forms and some related accident scenarios

D. Students fill out accident forms for each accident and complete the yearly report

E. Students discuss what OSHA does with the data it collects

F. Students discuss what OSHA learns from this information

G. Students discuss the types of careers available through OSHA

V. Occupational Safety and Health

A. Students differentiate between occupational safety and health

B. Students study the history of occupational safety and health in the United States

C. Students draw a time line of significant events in the history of occupational safety and health

D. Students read Bitter Wages or Work Is Dangerous to Your Health and participate in a class discussion concerning the need for occupational safety and health legislation

E. Students write an essay about the importance of occupational safety and health in industry

F. A union representative or safety officer conducts a class on some aspect of industrial safety

VI. Safety and Health Legislation

A. Students study the legal and regulatory agencies that affect safety in the work place and beyond

B. Students discuss the responsibilities and functions of each agency

C. A representative of one of these agencies comes in as a guest speaker or an agency film is presented to the class

D. Students discuss the costs of operating these regulatory agencies

E. Class determines who pays the cost of operating these regulatory agencies

F. Students decide on the significance of these regulatory agencies

VII. Occupational Safety and Health Legislation

A. Students do a case study of the Valdosta/Exxon oil spill.

B. Students learn about the cost of an industrial accident and its impact on the environment

C. Students do a field trip of a recycling center, toxic waste dump, or nuclear reactor and study the impact of the facility on the environment

D. Guest speaker discusses environmental problems within the community and discusses procedures for coping with them

VIII. Occupational Safety-Guarding

A. Students learn about the chief causes of injury around industrial machinery

B. Students define related terms such as danger zone, pinch point, and guard

C. Students are given a guarding problem in their lab

D. Students examine some examples of good guarding

E. Students sketch various solutions to the guarding problem

F. Solutions are evaluated by the teacher and the class

G. Students fabricate a mockup or prototype of the guard design(s) selected

IX. Occupational Safety-Guarding and Stock Control

A. Students study methods of controlling stock mechanically to keep hands clear of the danger zone

B. Students examine some examples of positive stock control

C. Students examine some examples of safe jigs and fixtures that control the tool or the stock

D. Teacher demonstrates how these jigs and fixtures work

E. Students are presented with a design problem related to stock control

F. Students build appropriate jig or fixture for the problem assigned

X. Safe Attitude 1

A. Students define attitude and discuss how attitudes affect performances at school or work

B. Students compare risk taking to safe attitude

C. Students respond to the following: If you perform a dangerous job or if you have a dangerous hobby, can you have a safe attitude?

D. Students respond to the following: Do you think that a person who does not wear protective equipment has a safe attitude?

E. Teacher names several sports heroes, and asks whether they have a safe attitude because they wear protective equipment when they play?

F. Students discuss ways in which their attitudes had been changed through experience

XI. Safe Attitude 2

A. Students discuss ways in which the work force demonstrates safe attitudes

B. Students discuss management policies concerning safety and their impact on safe practices and attitudes in the work place

C. Students examine a model safety pledge and discuss its effect on their attitude toward safety

D. Students write a philosophy of safety based on their experiences

E. Students break into groups to see if there are any common elements to their safety philosophy--results are reported to the class

XII. Personal Protective Equipment

A. Students discuss how a person's attitude toward safety can determine whether a person wears protective equipment or not

B. Students learn about various industrial injuries, illnesses, and diseases that are caused by noise, dust, flying particles, liquid splashes, and chemical contact

C. Students examine available personal protective equipment and learn to correct way of using the equipment

D. Students don protective glasses and the instructor smears the lenses with vaseline to blur the vision

E. Students try normal activities like writing, tying shoes, and chucking a drill bit while wearing the protective glasses

F. Students discuss their attitude toward safety after the above experience

G. Teacher initiates discussion how an attitude is changed through experience and looks for application

XIII. Product Liability 1

A. Product liability defined

B. Students are polled to see what they know about product liability and if they know of products that had product liability problems

C. Causes of liability problems

1. Manual

2. Warranty--explicit or implied safety

3. Product design or manufacture

D. Product callback is defined and students are polled to see what they have had any experience with a product callback

E. Students research a product that has been called back for repair or modification

XIV. Product Liability 2

A. Students examine the manufacturer's responsibility when a product is found defective--information sheet furnished

B. Students discuss the hidden costs of doing business related to product liability

C. Students learn the functions of the Consumer Product Safety Commission and examine some of the cases in which they have been involved

D. Students review a case of product liability from start to finish to learn problems, costs, and considerations

E. Values problem solving--What should a worker do if he/she feels that a product is dangerous or defective? Should parts that do not meet the quality control level be used anyway? What hidden costs could be involved with this practice?

F. Students do a case study of a "whistle blower" to see what happens to a person who acts correctly in a situation such as the one above

XV. Occupational Health Ergonomics 1

A. Students define terms related to ergonomics--student handout

B. Students examine several manufacturing products either physically or from catalog illustrations

C. Students evaluate the products for soundness of ergonomic design

D. Students learn about carpal tunnel syndrome and its industrial causes

E. Students make a connection between ergonomic design and trauma such as carpal tunnel syndrome

XVI. Occupational Health Ergonomics 2

A. Students bring in a household tool or product and evaluate it for ergonomic qualities

B. Students design a household computer terminal stand that is designed ergonomically

C. Students discuss why industrial health has surpassed industrial safety as an area of study

XVII. Safety in the Automated Environment

A. Robotics and related terms/definitions

B. Differentiate between typical manufacturing facility and robotics facility

C. Students observe robotics--table top or field trip

D. Safety and robotics--What are the differences?

E. Student groups develop some guidelines concerning robotics safety

F. Student groups share their guidelines with the class and develop a document on robotics safety

G. Safety director evaluates document and discusses robotics safety

XVIII. The Safe Environment

A. Information sheet--industrial environment factors

B. Tools and equipment
Housekeeping
Noise
Lighting
Ventilation
Floors and walking surfaces

C. Students assess the factors in assigned lab

D. Class evaluation and recommendations for improvement

XIX. Worker's Compensation

A. History of Worker's Compensation

B. The tradeoff of Worker's Compensation

C. Study state Worker's Compensation Plan

D. Evaluate coverage and compensation

E. Financing of Worker's Compensation

F. High-injury industries

XX. Fire Safety

A. Fire causes

B. Fire categories and appropriate extinguisher

C. Extinguisher practice with fire department

D. Walk through fire inspection with fire department

E. Careers in fire safety

XXI. Electrical Safety

A. Electrical delivery systems

B. Causes of electrical accidents and electrocutions

C. Work place inspection for electrical safety

D. Coping with electrical hazards--safety pamphlet

Unit Goals - Business Economics

Upon successful completion of this unit, the learner will be able to:

1. Define capitalism and tell how it differs from communism and socialism as a form of government.

2. Define the terms "profit" and "loss" and discuss why "profit" is important to success in manufacturing.

3. Describe how profits are divided among workers, executives, and shareholders. Discuss the percentages of profit that are used as compensation and reinvestment.

4. Name and describe the elements that must be considered when determining unit cost and list price of a product.

5. Define "overhead" and list at least 10 factors that can be included in product overhead.

6. List at least 10 types of employee benefits commonly furnished in most industries.

7. Describe the impact employee benefits have on overhead and the development of a talented work force.

8. Analyze an industrial concern for assets, liabilities, overhead, relative value, and potential for growth.

9. Define the term "inventory" and discuss its impact on profit and cash flow.

10. Define the term "value added" and trace a raw material through the steps required to become a part or finished product.

11. Define the term "human resources" and discuss the impact human resources have on profit and overhead.

12. Analyze a consumer problem caused by a manufactured product and trace the steps required to gain customer satisfaction.

13. Discuss the impact of customer satisfaction on overhead and reputation.

14. Trace the history of consumer rights in the United States. Cite events that have changed how consumers regard and buy products.

15. Define the term "truth in advertising" and name the agency that governs truth in advertising.

Unit Outline - Business Economics

I. Government and Industry

- A. Capitalism--our form of government
- B. How government controls industry
- C. Free trade and trade barriers

II. Profit and Loss

- A. Definition of related terms
- B. Examination of success and failures in manufacturing--In Search of Excellence, Chrysler bailout
- C. Forces affecting profit: competition, quality, reputation, supply, and demand
- D. Cash flow and its impact on profits
- E. Profit distribution in industry

III. The Cost of Doing Business

- A. Cost factors related to industry's reputation
- B. Cost factors related to quality control
- C. Expenses (overhead) within the industry
- D. The impact of overhead on an industry's profit
- E. The actual value of an industry--What is its worth?

IV. The Cost of a Profit

A. The cost of the technology

B. The cost of the design

C. Fabrication and manufacturing costs

D. The value added operations

E. How the list price of a product is determined

F. The effect of volume and advertising on list price and profit

G. Terms of sale, billing, and cash flow

V. Human Resources

A. Who they are

B. Importance of human resources

C. Upgrading human resources

D. Loyalty--the obligation of the employee and the employer

E. Education and experience--the key factors

F. The cost of human resources

VI. Employee Benefits

A. The wage that is not on your paycheck

B. The purposes of employee benefits

C. Some types of employee benefits

D. Employee benefits as a cost of doing business

E. The competition for good employees

F. Benefits vs. paycheck--Which job is best for you?

G. Wage and salary administration--how compensation changes

VII. Consumer Rights and Safeguards

A. Definition of Terms

B. What is a warranty/guarantee?

C. Advertising a product fairly

D. The importance of quality to the consumer and manufacturer

E. Case histories of products--Corvair, Maytag

F. The employee's effect on overall quality and product return

G. The effect of the media on consumer satisfaction

VIII. Keeping the Customer Happy

A. Getting a customer/keeping a customer

B. Parts availability

C. Repair services

D. Consumer hotlines

Unit Goals - Measurements, Drawing Interpretation, Layout, and Inspection

As a result of this unit, the student will be able to:

In Regard to Measurement:

1. Display a comprehensive understanding of measurement's role in manufacturing.

2. Identify measurements taken in manufacturing the tools/gauges with which they are measured.

3. Know and identify units in measuring systems and convert units from one system to another.

4. Demonstrate ability to use standard measuring tools.

5. Apply the concepts of precision, accuracy, and tolerances.

6. Describe future trends and technologies in measuring devices used in manufacturing.

7. Apply concepts of measurement to production activities in order to solve problems.

8. Select and evaluate various measuring tools and techniques at given points in the production process.

In Regard to Drawing Interpretation:

9. Identify and explain detailed drawing items and make appropriate selections in regard to such things as machining, materials, size, assembly, and inspection.

10. Interpret drawing elements to correctly lay out, plan, produce, and inspect parts or assemblies.

11. Compare the limited uses of traditional prints with those of CADAM.

12. Discuss the future effects that electronic communications will have in regard to linking engineering and production.

In Regard to Layout:

13. Evaluate and apply various layout tools and techniques.

14. Choose and employ proper layout procedures.

15. Explain advances in automated or programmed layout.

16. Apply procedures used in production layouts.

In Regard to Inspection:

17. Discuss the roles of inspection in production.

18. Choose and employ proper inspection procedures.

19. Identify and discuss trends in quality and competition which have increased the role of inspection.

20. Perform inspections both as a team and as an individual.

21. Develop and assess inspection procedures as part of a quality control team.

22. Assess how advancing inspection technologies are affecting industry.

23. Identify and explain types of automated inspection equipment.

Unit Outline - Measurements, Drawing Interpretation, Layout, and Inspection

Measurement:

I. Define Measurement

II. Purposes of Measurement

- A. Interchangeable parts
- B. Manufacture to correct specifications

III. Measuring Systems

- A. British Imperial Units
  - 1. Fractional inch
  - 2. Decimal inch
- B. Metric Units (System International)

IV. Static Physical Measurements

- A. Linear
- B. Straightness
- C. Concentricity (cylindrical and taper)
- D. Angular
- E. Areas
- F. Volumes
- G. Surface textures
- H. Mass and weight

V. Dynamic Physical Measurements

A. Speed

B. Fluid pressures

C. Moving volumes

1. Gal./minute

2. SCFM

D. Torque

VI. Other Measured Properties

A. Conductivity

B. Hardness

VII. Electrical Measurements

A. Volts

B. Amperage

C. Ohms

D. Watts

VIII. Degrees of Accuracy

A. Semi-precision

B. Precision

C. Tolerance

D. Allowance

IX. Linear Measuring Devices

A. Steel rules

B. Measuring tapes

C. Transfer devices

1. Dividers

2. Outside calipers

3. Inside calipers

4. Hermaphrodite calipers

D. Combination set

E. Vernier calipers

F. Micrometers

X. Angular Measuring Devices

A. Protractor

B. Vernier protractor

C. Sine bar

D. Optical comparator

E. Sliding T bevel

F. Try square

G. Framing square

XI. Surface Measuring Devices

A. Surface texture gage

B. Optical flats

C. Surface bluing

D. Dial indicators

Drawing Interpretation:

XII. Feature Identification

Lines and symbols
Title blocks
Notes (general and local)
Views
Dimensions and tolerances

Fractional
Decimal
Metric

Sections
Machine symbols
Threading

Drawing Interpretation:

XII. Feature Identification

- Lines and symbols
- Title blocks
- Notes (general and local)
- Views
- Dimensions and tolerances
  - Fractional
  - Decimal
  - Metric
- Sections
- Machine symbols
- Threading

Layout:

- Analyze specifications
- Compute layout dimensions
- Plan layout operations
- Label work piece
- Perform semi-precision layouts
- Perform precision layouts from blueprints
- Surface plate work
- Layout tools and instruments

Inspection:

- Precision measurements
- Surface condition
- Quality control

Unit Objectives - Product and Process Control

Having completed this unit, the student will be able to:

1. Define product control.
2. Define process control.
3. Define the roles of designers and engineers in the development of a product.
4. State four main factors a company must consider when selecting a design for a new product which is to be manufactured.
5. Explain the importance of process design as used in a manufacturing system.
6. Name five factors a company must consider when developing a process plan for a manufacturing system.
7. Name and explain the differences between the three types of manufacturing systems.
8. Explain why jigs and fixtures are important to the manufacturing process.
9. Explain the importance of inventory control.
10. Complete a bill of materials for a product.
11. Complete a material requisition.
12. List the manufacturing processes needed to produce a product in the lab.
13. Estimate production time for a product to be made in the lab.
14. Name three kinds of company costs as a result of producing a product.
15. Explain two types of manufacturing inventory systems.
16. Explain the importance of vendor quality control.
17. Discuss several methods for transferring materials from a storage area to the production area.

18. Trace the steps of process planning.

19. List four factors involved in determining plant layout.

20. Discuss and the importance of a flow diagram.

21. Design and develop a flow diagram for a product to be made in the lab.

22. Develop a safety chart for the production operations.

23. Discuss three factors which would have an effect on the movement of work-in-process.

24. Explain the importance of departmental integration in the manufacture of a product.

25. Discuss the importance of material handling systems in the manufacture of a product.

26. Name four types of material handling systems.

27. Name three times when materials or products are inspected.

28. List four methods of inspection processes used to check for defects.

29. Explain statistical process control.

30. Discuss several reasons why a production run may turn out nonconforming parts.

31. Explain the importance of preventive maintenance.

32. Explain the effect of quality circles in a manufacturing system.

33. Discuss the impact of automation on a manufacturing system.

34. Compare and contrast NC, CNC, DMC, CIM, FMS.

35. Discuss the effect of work cell applications in manufacturing.

36. Make a list of variables which may affect production.

37. Explain the importance of packaging and storage of products.

38. Name several factors which are important in the packaging and storage of a product.

39. Design a package or container for the product produced in the lab.

40. Complete a shipping invoice for a product.

Unit Outline - Product and Process Control

I. Design

A. Product design

1. Cost of material
2. Economic use of material
3. Optimal material properties
4. Efficiency of manufacturing process
   a. Tolerance limitations
   b. Quality of parts
   c. Use of existing manufacturing resources
   d. Finished product cost
5. Interchangeability of parts

B. Process design

1. Type of manufacturing system
   a. Custom (e.g., tool and die)
   b. Intermittent or job lot (e.g., blow molding several plastic bottles)
   c. Continuous or line (e.g., stamping or plywood manufacturing
2. Tooling requirement
3. Machine requirements
4. Size and shape of parts
5. Number of parts to be produced
6. Surface finish requirements
7. Type of materials used
8. Tolerances to be held
9. Jigs and fixtures to be used
10. Personnel requirements

II. Inventory

A. Material Requirement Planning (MRP)

1. Material availability
2. Bill of materials
3. Requisition of materials
4. Manufacturing process requirements

B. Production planning inventory

1. Just in time inventory (JIT)
2. Material warehousing
   a. First in, first out (FIFO)
   b. Last in, first out (LIFO)

C. Vendor quality control

1. Receiving inspection
2. Nonconforming material storage

D. Transfer of material

III. Plant Layout

A. Type of manufacturing system

1. Custom
2. Intermittent or job lot
3. Continuous or line

B. Type of product

1. Materials to be used
2. Quantity needed
3. Sequence of operations
4. Number of stations

C. Type of manufacturing equipment

1. Manual
2. Automated

D. Transfer systems

1. Mechanical
2. Computerized

E. Flow diagram

1. Equipment location
2. Work station location
3. Open space requirements
4. Storage space
5. Movement of work-in-progress
   a. Product flow
   b. Lot size
   c. Time and motion
   d. Line balancing
   e. Critical path method (CPM)
6. Size and numbers of machines
7. Location of accessories
   a. Compressed air
   b. Electricity
   c. Water

F. Flexibility of layout design

1. Product adaptability
2. Future trends

G. Employee safety and job satisfaction

H. Departmental integration

IV. Material Handling Systems

A. Size and shape of materials to be moved

B. Floor space availability

C. Materials handling equipment

1. Conveyors
2. Hoists and cranes
3. Industrial trucks
4. Robots

D. Automated material handling systems

E. Employee safety

F. Cost effectiveness

G. Time efficiency

H. Vision systems

V. In-Process Product Control

A. In-process inspection

1. Inspection standards
2. Measurement - precision tools
3. Gauging
4. Visual inspection
5. Inspection report

B. Frequency of inspection

1. First-run piece
2. Last-run piece
3. Periodic part check

C. Statistical process control (SPC)

1. Computer analysis
2. Failure mode effect analysis (FMEA)
3. Statistical quality control (SQC)
4. Adaptive control

D. Nonconforming parts

1. Direct machine variance
2. External variance

E. Corrective action

F. Preventive maintenance

G. Final testing

H. Zero defects

I. Quality circles

J. Process layout inspection

VI. Automation

A. Fixed

1. High cost
2. Inflexible

B. Programmable

1. Numerical control (NC)
2. Computer numerical control (CNC)
3. Direct numerical control (DNC)

4. Computer integrated manufacturing (CIM)
5. Flexible manufacturing systems (FMS)

C. CAD/CAM Link

D. Work cell applications

E. Production variables

1. Machine design
2. Cost effectiveness
3. Efficiency
4. Product type

VII. Packaging and Storage

A. Protective packaging

B. Product identification

C. Automated storage and retrieval systems

D. Shipping

Unit Goals - Quality

1. Define "quality in manufacturing" and explain why it is important.
2. Match modern manufacturing terminology with the correct definitions.
3. List the major points of the Design for Manufacturing (DFM) concept.
4. Conduct tests and reviews to ensure quality in product design.
5. Establish procedures for maintaining quality of incoming material and vendors.
6. Conduct studies and reviews to ensure quality of production.
7. Establish methods, plans, and procedures for maintaining quality at various points in the production process.
8. Develop plans for packaging and shipping quality control.
9. Simulate product liability legal actions.
10. Establish procedures for handling complaints and claims for a given product and create a product recall plan.
11. Develop methods for measuring customer satisfaction.
12. Establish procedures for maintaining quality customer service.
13. Collect and evaluate data relative to quality costs.
14. Develop a quality cost improvement project.

I. Introduction Outline for Quality in Manufacturing:

A. What is quality and why is it important?

1. Define quality

2. Cost of ignoring quality

B. Quality tools

1. Statistics

a. Frequency distribution
b. Control charts
c. Sampling tables
d. Special methods
e. Product reliability

2. SPC
3. JIT
4. kanban
5. poka-yoke
6. SMED

I. Introduction Objectives for Quality in Manufacturing (Student will be able to - SWBAT)

A. SWBAT define the term "quality" as it relates to a manufacturing environment.

B. SWBAT, when given the proper data, produce control charts and sampling tables for a particular manufacturing process.

SWBAT define the following terms as they relate to manufacturing quality: JIT, kanban, poka-yoke, SPC, and SMED.

II. Design Quality Outline for Quality in Manufacturing

A. Design for Manufacture (DFM)

1. The DFM Process

a. Proposed product concept
b. Proposed process plan
c. Design goals
d. Optimize product/process
e. Engineering release package

(1) Part drawings
(2) Parts list
(3) Assembly drawings
(4) Process plan

2. Tools and Methodologies for DFM

a. Tools

(1) Design axioms
(2) DFM guidelines
(3) Design for assembly method
(4) Taguchi method
(5) Manufacturing process design rules
(6) Designers tool kit
(7) Computer-aided DFM
(8) Group technology
(9) FMEA
(10) Value analysis

b. Methodologies

(1) Implementation cost and effort
(2) Training and/or practice
(3) Designer effort
(4) Management effort
(5) Product planning/team approach
(6) Rapidly effective
(7) Stimulates creativity
(8) Systematic
(9) Quantitative
(10) Teaches good practice

B. New Design Control Sequence

1. Preproduction Analysis

a. Design reported
b. Preliminary design review
c. Reliability, safety, maintainability testing program
d. Corrective actions
e. Intermediate design review
f. Continuation of testing
g. Corrective action
h. Final product drawings, specifications, and guarantees

2. Pilot Runs

a. Gather data on component and first production tools and processed parts
b. Corrective action
c. Reliability and safety tests on completed assemblies
d. Corrective action

e. Final design review
f. Product qualification tests
g. Release for production and sale

II. Design Quality Objectives for Quality in Manufacturing

A. SWBAT list the major points in the concept of Design for Manufacture (DFM)

SWBAT utilize the tools and methodologies of DFM to accomplish the following:

1. As a member of a planning team, develop a process plan when given the raw data for a particular product

2. As a design team member:

a. Determine design goals for a given product

b. Product an engineering release package consisting of parts drawings, parts lists, assembly drawings, and a process plan

B. SWBAT utilize the concepts of New Design Control to accomplish the following as a design team member:

1. Conduct a preliminary design review.

2. Conduct an intermediate design review.

3. Conduct reliability and safety tests on completed assemblies.

4. Conduct a final design review.

5. Conduct product qualification tests.

6. Release a product for production and sale.

III. Incoming Material Quality (IMQ) Outline for Quality in Manufacturing

A. Definition

1. Involves receiving and stocking, at the most economical levels of quality, of only those parts whose quality conforms to the specification requirements, with emphasis upon the fullest practical vendor responsibility

B. Phases

1. Establish vendor responsibility and surveillance
2. Control of external sources
3. Control of internal sources

C. Major Activities

1. Material request and specifications
2. Purchase analysis
3. Vendor election and order placement
4. Material receipt
5. Material examination
6. Material disposal
7. Record keeping and followup
8. Vendor relations and vendor surveillance

III. Incoming Material Quality (IMQ) Objectives

A. SWBAT write a practical definition of IMQ as it applies to modern manufacturing.

B. SWBAT match the definitions commonly used for the phases of IMQ with the proper title.

C. SWBAT, as a member of an incoming quality control team, do the following:

1. Establish material specifications for a given manufacturing situation.

2. Select vendors from a given list to match predetermined specifications.

3. Create procedures for incoming material examination and inspection.

4. Establish procedures for material disposal.

5. Establish procedures for maintaining vendor relations and surveillance.

IV. Product Quality Outline for Quality in Manufacturing

A. Definition

1. Involves the control of products at the source of production and through field service so that departures from the quality specification can be corrected before defective or nonconforming products are manufactured and the proper service can be maintained in the field to assure full provision of the intended customer quality.

B. Phases

1. Control of machining or processing of components.

2. Control of assemblies and packaging of batches.

3. Control of customer product service.

C. Techniques Used in Product Control

1. Setting and Maintenance of Standards

a. Process capability studies
b. Tool, die, jig, and fixture control
c. Software program control
d. Preventive maintenance
e. Accounting standards on quality cost
f. Process quality design review
g. System planning for calibration and maintenance of equipment

2. Control During Manufacture

a. Shop personnel quality mindedness
b. Proper material flow
c. Planning for mechanical inspection and electrical test procedures
d. Nondestructive evaluation
e. Control charts
f. Process sampling tables
g. Process-drift and tool-wear studies
h. Acceptance sampling tables
i. Another statistical techniques

j. Quality audit
k. Quality level index
l. Final inspection data
m. Process control computing devices
n. Disposing of nonconforming parts
o. Major-part record forms
p. Complaint analyses
q. Regular quality performance or reject breakdown reports

3. Control of Quality in Packaging and Shipping

4. Control of Field/Customer Service

IV. Product Quality Objectives for Quality in Manufacturing

A. SWBAT define the scope of product quality in terms of modern manufacturing.

B. SWBAT match the definitions commonly used for the phases of product quality with the proper title.

C. SWBAT, as a member of a product control team, do the following:

1. Conduct a process capability study.

2. Set standards for preventive maintenance.

3. Conduct a process quality design review.

4. Establish proper methods for material flow for a given production process.

5. Establish a plan for the mechanical inspection of a given product.

6. Establish the electrical test procedures for a given product.

7. Using various statistical techniques, conduct a quality audit for a given product.

8. Establish a procedure for disposing of nonconforming parts.

9. Develop a plan for packaging quality control.

10. Develop a plan for shipping quality control.

11. Establish procedures for quality customer service for a given product.

V. Product Liability Outline for Quality in Manufacturing

A. Introduction

1. History of product liability
2. Consumer Product Safety Act

B. Legal Aspects

1. Product Liability Law
2. The plaintiff
3. The defendant
4. Expert witness
5. The outcome
6. Financial loss

C. Prevention

1. Organization
2. Education
3. New product review
4. Initial production review
5. Periodic production audits
6. Control of warranties, advertisements, agreements, and the like
7. Complaints and claims
8. Records retention
9. Product recall plan
10. Subrogation
11. Risk criteria
12. Standards
13. Audit

V. Product Liability Objectives for Quality in Manufacturing

A. SWBAT identify the major purposes of the Consumer Product Safety Act.

B. SWBAT, as part of a simulation team, enact the legal aspects of product liability law to include: the plaintiff, the defendant, expert witnesses, the outcome, and financial loss.

C. SWBAT, as part of a product liability team, do the following:

1. Conduct a new product review.
2. Conduct in initial production review.
3. Conduct periodic production audits.
4. Establish the warranty and advertisement for a given product.
5. Establish procedures for handling claims and complaints for a given product.
6. Create a product recall plan for a given product.

VI. Field/Customer Service Outline for Quality in Manufacturing

A. Orientation to Customer Satisfaction

B. Measurement of Customer Satisfaction

C. Customer Attitude

D. Promotion of Quality to Customer

E. Field Complaint Analysis

F. Field Performance

VI. Field/Customer Service Objectives

SWBAT, as part of a Customer Service Quality Team, do the following:

A. Prepare a plan to orient employees to customer satisfaction.

B. Develop instruments and methods for measuring customer satisfaction for a given product.

C. Create a program to promote the quality of a given product to an established customer base.

D. Establish procedures for evaluation of field performances.

VII. Quality Costs Outline for Quality in Manufacturing

A. Introduction

B. Direct Quality Costs

1. Prevention
2. Appraisal
3. Internal Failure
4. External Failure

C. Indirect Quality Costs

D. Collection and Evaluation

1. Collecting Data
2. Measurement Base
3. The Optimum Cost

E. Analysis

1. Operating Quality Cost Report
2. Trend Analysis
3. Pareto Analysis

F. Additional Aspects

1. Program Phases
2. Quality Cost Improvement Projects
3. Capital Quality Costs

VII. Quality Cost Objectives for Quality in Manufacturing

SWBAT, as part of a Quality Cost Analysis Team, do the following:

A. For a given product, collect data relative to direct costs involving prevention, appraisal, internal and external failure.

B. For a given product, collect data relative to indirect costs.

C. For a given product, evaluate quality costs and determine an optimum cost.

D. When provided data for a given product, generate the following reports:

   1. Short-range operating quality cost report
   2. Long-range product trend analysis
   3. A Pareto distribution and a plan to reduce the costs of one of the "vital few"

E. When provided data for a given product, develop a quality cost improvement project from the following list:

   1. Zero-Defect Program
   2. Supplier Rating System
   3. Supplier Defective Material Recovery
   4. Inspection System Analysis

Goals for Marketing and Promoting Manufacturing Skills

Upon completion of this unit, the students will be able to (SWBAT):

1. Identify their personal interests, values, and skills.
2. Determine their primary communication style.
3. Establish realistic job goals.
4. Effectively use the telephone to arrange interviews.
5. Identify sources of employment.
6. Develop an effective resume for marketing manufacturing skills.
7. Write effective cover and thank you letters.
8. Complete an employment application.
9. Prepare for and pass simulated oral and written employment tests.
10. Prepare for and pass a simulated employment interview.
11. Evaluate offers of employment based upon job goals.
12. Determine possible workplace conflicts and develop strategies for coping with them.
13. Develop guidelines for establishing relationships with people in the workplace.

Marketing and Promoting Manufacturing Skills

Job Search

I. Know Yourself Outline for Manufacturing Skills:

A. Identify Your Interests
B. Define Your Values
C. Identify Your Accomplishments
D. Identify Your Skills
E. Establish Your Communications Style
F. What You Want To Do
G. What Can You Do
H. Establish a Realistic Job Goal

Know Yourself Objectives for Manufacturing Skills:

SWBAT complete the following for use in the job search process:

a personal interest inventory
a personal values inventory
a personal skills inventory

SWBAT determine which of the following is their primary communication style:

Intuitor
Senser
Thinker
Feeler

SWBAT, based upon the results of personal inventories of interests, values, and skills, establish realistic job goals.

II. Communications Outline for Manufacturing Skills

A. How to Use the Telephone
B. How to Write Effective Letters
C. How to Interview Effectively

Communication Objectives for Manufacturing Skills

SWBAT, based upon the results of team efforts, effectively use the telephone to arrange interviews and conduct followup.

SWBAT write effective business letters.

SWBAT, after using the group process, prepare for and interview effectively.

III. Job Search Tools Outline for Manufacturing Skills

A. Sourcing
B. Networking
C. Resume Writing
D. Employment Applications
E. Cover and Thank You Letters

Job Search Tools Objectives for Manufacturing Skills:

SWBAT identify sources of possible employment.

SWBAT evaluate sources to determine which offer the best opportunities for employment.

SWBAT establish a personal networking strategy for assistance in the job search, using a group process.

SWBAT develop an effective resume for marketing manufacturing skills, using a group process.

SWBAT complete a sample employment application form.

SWBAT write effective cover and thank you letters.

IV. The Job Search Outline for Manufacturing Skills

A. Planning
B. Obtain Interview
C. Obtain Offer
D. Evaluate Offers

The Job Search Objectives for Manufacturing Skills:

SWBAT develop an effective Job Search Plan.

SWBAT maintain a "Resumes Sent" diary.

SWBAT prepare for and pass simulated oral and written employment tests.

SWBAT prepare for and complete a simulated employment interview.

SWBAT evaluate offers of employment based upon previously determined realistic job goals.

V. Surviving the New Job Outline for Manufacturing Skills

A. The First Three Months

1. Communication Styles
2. Possible Conflicts

B. Strategies for Retention and Promotion

1. Work Performance
2. Demeanor
3. The Organization
4. Relationships

Surviving the New Job Objectives for Manufacturing Skills:

SWBAT determine the communication styles of their supervisors and co-workers, using group evaluation processes.

SWBAT evaluate workplace communication styles and determine possible conflicts with their own style.

SWBAT develop possible strategies for coping with communication style conflicts in the workplace.

SWBAT identify work performance characteristics which will assist in making a good first impression on the job.

SWBAT identify demeanor characteristics which are successful in the workplace.

SWBAT develop skills for determining the true structure of authority in the workplaces.

SWBAT develop guidelines for establishing relationships with people in the workplace.

APPENDIX C

SUMMARY OF MANUFACTURING CURRICULUM QUESTIONNAIRES

INTRODUCTION

The Manufacturing Curriculum Questionnaire was used to validate entry-level manufacturing topics identified by a panel of experts and refined by the research group. The questionnaire was sent to 86 manufacturing facilities in the state of Illinois. These facilities varied in size and function. As of May 30, 2989, 30 questionnaires had been returned.

Those responding hired an average of 12 entry-level employees per year. Thirty-one employers hired persons with a high school diploma or above. Twelve employers hired only persons with a baccalaureate degree. Employers typically did 80% of the necessary training on the job.

The questionnaire had four pages of manufacturing-related topics under the following headings: Technical Concepts, Employability and Interpersonal Skills, Computer Literacy, and Business Economics. Each respondent was asked to rank the top five topics under each heading. Each topic was then rated on a scale of 1 to 5, according to how important the topic is and how often it is used by an entry-level employee.

PROCEDURE

Rankings were studied under each heading. To evaluate the rankings, each topic was assigned a number, based on the number of first-place rankings it received--the higher the number, the more important the topic. All topic ratings were averaged. These averages help identify the topics manufacturing firms feel are necessary for the success of entry-level employees. The findings for each group are reported below.

PRESENTATION OF THE DATA

Technical Concepts:

Top Five Rankings:

2. (7) Quality Control-Manual and Automated including SPC

2. (7) Safe Work Practices and Attitudes

3. (4) Blueprint Reading

5. (3) Precision Measurement

5. (3) Research & Development

Top Seven Rating Averages:

How Important--

4.7 Safe Work Practices & Attitudes

4.6 Quality Control

4.2 Product & Process Cont.

4.1 Plant Layout

4.0 Blueprint Reading

3.9 Precision Measurement

3.9 Inventory Control

How Often Used--

4.7 Safe Work Practices & Attitudes

4.7 Quality Control

4.1 Inventory Control

4.0 Blueprint Reading

3.9 Product & Process Cont.

3.9 Linear Measurement

3.8 Product Packaging

Employability and Interpersonal Skills:

Top Five Rankings:

1. (13) Teamwork, Group Process, Team Building, & Interaction

3. (4) Creative/Innovative Problem Solving

3. (4) Oral Communication

5. (3) Decision Making-Effective Reasoning

5. (3) Listening Communication

Top Seven Rating Averages:

How Important--

4.6 Teamwork, Group Process

4.6 Oral Communication

4.5 Listening Communication

4.4 Decision Making-Effective Reasoning

4.2 Workplace Ethics

4.2 Written Communication

3.8 Advancing on the Job

How Often Used--

4.7 Oral Communication

4.6 Listening Communication

4.3 Teamwork

4.3 Decision Making

4.2 Creative/Innovative Problem Solving

4.1 Workplace Ethics

3.8 Communication

Computer Literacy:

Top Five Rankings:

1. (7) Traditional Typing Keyboard

2. (5) Using the Operating System, i.e., MS/DOS

3. (3) Use Spreadsheet Software

5. (2) Keyboard Skills

5. (2) Use Word Processing Software

Top Seven Rating Averages:

How Important--

3.9 Traditional Typing Keyboard

3.7 Specialty Keyboard

3.7 Use Spreadsheet Software

3.5 Use the Operating System

3.4 Use Database Software

3.3 Use Word Processing Software

3.0 Use Communication Software

How Often Used--

4.0 Use the Operating System

4.0 Traditional Typing Keyboard

3.6 Specialty Keyboard

3.6 Use Spreadsheet Software

3.3 Use Word Processing Software

3.1 Use Database Software

2.9 Use Communication Software

Business Economics:

Top Five Rankings:

1. (9) Customer Satisfaction

2. (6) Profit/Loss

3. (4) Cost of Product

5. (2) Corporate Goals

6. (2) Global Competition

Top Seven Rating Averages:

How Important--

4.6 Customer Satisfaction

4.3 Overhead/Fixed Costs

4.2 Cost of Product

4.2 Customer Service Warranty, Repair, etc.

4.0 Inventory

4.0 Profit/Loss

4.0 Workman's Compensation

4.0 Product Liability

How Often Used--

4.3 Customer Satisfaction

4.2 Cost of Product

4.0 Inventory

3.8 Profit/Loss

3.8 Overhead/Fixed Costs

3.8 Customer Service Warranty, Repair, etc.

3.7 Union/Management Relations

How Important: 1 = No Value
2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank			Technical Concepts	Averages	
3	2	1		How Important	How Often Used
2	2	2	Linear Measurement	3.4	3.9
3	1	3	Precision Measurement	3.9	3.0
3	2	4	Blueprint Reading	4.0	4.0
2	6	0	Inventory Control - Manual & Automated - Including JIT	3.9	4.1
5	4	7	Quality Control - Manual & Automated - Including SPC	4.6	4.7
0	1	0	Manufacturing Concepts		
0	1	1	Cellular/Group Technology	2.8	2.3
1	1	1	Automation/Electronic Control	3.4	3.1
3	0	3	Research & Development	3.2	3.3

How Important: 1 = No Value
2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank			Technical Concepts	Averages	
3	2	1		How Important	How Often Used
1	2	1	Product Design	3.4	3.2
0	0	1	Simulation	2.8	2.5
3	5	1	Product & Process Control	4.2	3.9
1	1	0	Plant Layout	3.6	3.8
3	0	0	Product Packaging	3.1	3.3
1	1	1	Product Distribution	3.1	3.3
0	1	2	Understand the CADD/CAM Link	2.9	2.5
3	0	7	Safe Work Practices & Attitudes	4.7	4.7
			Other Topics - Please List:		

COMMENTS:

50

How Important: 1 = No Value
2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank			Employability and Interpersonal Skills	Averages	
3	2	1		How Important	How Often Used
3	3	13	Teamwork - Group Process, Team Building & Interaction	4.6	4.3
7	3	3	Decision Making - Effective Reasoning	4.4	4.3
5	4	4	Creative/Innovative Problem Solving	3.7	4.2
1	0	0	Understanding Social, Cultural & Language Differences	3.0	3.7
2	2	2	Workplace Ethics	4.2	4.1
0	0	0	Community Involvement - Giving Something Back to the Community	3.0	3.0
1	1	0	Adaptability/Coping with Change		

How Important: 1 = No Value
2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank			Employability and Interpersonal Skills	Averages	
3	2	1		How Important	How Often Used
1	3	0	Communication	3.7	3.8
5	2	1	Written	4.2	4.2
0	4	4	Oral	4.6	4.7
3	3	3	Listening	4.5	4.6
0	0	0	Procuring a Job	3.3	3.1
0	2	0	Advancing on the Job	3.8	3.5
0	0	1	Understanding the Corporate Structure	3.5	3.0
			Other Topics - Please List:		

COMMENTS:

How Important: 1 = No Value
2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank			Computer Literacy	Averages	
3	2	1		How Important	How Often Used
2	0	5	Using the Operating System i.e., MS/DOS	3.5	4.0
0	1	2	Keyboard Skills		
1	5	7	Traditional Typing Keyboard	3.9	4.0
4	5	0	Specialty Keyboard - Function Keys & Numeric Pad	3.7	3.6
6	2	2	Use Word Processing Software	3.3	3.3
2	1	1	Use Data Base Management Software	3.7	3.1
2	4	3	Use Spreadsheet Software	3.7	3.6
2	0	0	Use Communication Software	3.0	2.9
			Other Topics - Please List:		

COMMENTS:

How Important: 1 = No Value
2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank				Averages	
3	2	1	Business Economics	How Important	How Often Used
2	5	4	Cost of Product	4.2	4.2
5	1	0	Inventory	4.0	4.0
1	1	6	Profit/Loss	4.0	3.8
0	3	1	Profit Margin	3.8	3.4
0	0	1	Cash Flow	3.8	3.3
1	0	2	Corporate Goals	3.9	3.5
1	0	0	Corporate Policies	3.6	3.3
0	0	1	Supply/Demand	3.3	2.9
1	0	2	Global Competition	2.8	2.4
3	2	1	Overhead/Fixed Costs	4.3	3.8

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2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank			Business Economics	Averages	
3	2	1		How Important	How Often Used
0	1	1	Workman's Compensation	4.0	3.5
0	0	0	Community/Civic Responsibility	3.3	2.9
1	1	1	Union/Management Relations	3.7	3.7
0	0	0	Customer Service - Warranty		
3	5	0	Repair, Satisfaction, Parts	4.2	3.8
5	2	9	Customer Satisfaction	4.6	4.3
3	3	0	Product Liability	4.0	3.6
			Other Topics - Please List:		

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COMMENTS:

FINAL RESULTS

How Important: 1 = No Value
2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank			Technical Concepts	Averages	
3	2	1		How Important	How Often Used
5	4	2	Linear Measurement	4.1	3.9
3	5	4	Precision Measurement	4.2	4.1
7	3	7	Blueprint Reading	4.0	4.0
3	7	0	Inventory Control - Manual & Automated - Including JIT	3.7	3.9
7	5	11	Quality Control - Manual & Automated - Including SPC	3.9	4.5
0	1	0	Manufacturing Concepts		
0	1	1	Cellular/Group Technology	2.3	2.8
2	1	3	Automation/Electronic Control	3.3	2.9
4	0	5	Research & Development	3.2	3.4

How Important: 1 = No Value
2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank			Technical Concepts	Averages	
3	2	1		How Important	How Often Used
1	3	1	Product Design	3.3	2.9
0	0	1	Simulation	2.9	2.5
3	8	3	Product & Process Control	4.2	4.2
2	1	0	Plant Layout	4.0	3.3
4	0	0	Product Packaging	3.6	4.2
1	1	1	Product Distribution	3.2	3.3
0	2	2	Understand the CADD/CAM Link	2.6	2.6
4	1	14	Safe Work Practices & Attitudes	4.7	4.7
			Other Topics - Please List:		

COMMENTS:

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How Important: 1 = No Value
2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank			Employability and Interpersonal Skills	Averages	
3	2	1		How Important	How Often Used
4	5	20	Teamwork - Group Process, Team Building & Interaction	4.7	4.6
9	6	5	Decision Making - Effective Reasoning	4.4	4.3
9	7	5	Creative/Innovative Problem Solving	4.1	4.2
1	0	0	Understanding Social, Cultural & Language Differences	2.9	3.3
3	3	2	Workplace Ethics	4.3	4.0
0	0	0	Community Involvement - Giving Something Back to the Community	3.4	3.3
1	2	0	Adaptability/Coping with Change		

How Important: 1 = No Value
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3 = Useful
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5 = Very Important

How Often Used: 1 = Never
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4 = Often
5 = Very Often

Rank			Employability and Interpersonal Skills	Averages	
3	2	1		How Important	How Often Used
3	4	4	Communication	4.3	4.7
6	3	1	Written	4.2	4.0
0	5	5	Oral	4.7	4.7
4	4	4	Listening	4.7	4.7
1	0	0	Procuring a Job	3.7	3.4
0	3	0	Advancing on the Job	4.0	3.8
0	0	2	Understanding the Corporate Structure	3.5	3.0
			Other Topics - Please List:		

COMMENTS:

How Important: 1 = No Value
2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank				Averages	
3	2	1	Computer Literacy	How Important	How Often Used
3	2	6	Using the Operating System i.e., MS/DOS	3.8	3.9
0	1	2	Keyboard Skills		
5	7	9	Traditional Typing Keyboard	3.8	4.0
6	5	2	Specialty Keyboard - Function Keys & Numeric Pad	3.7	3.6
6	5	3	Use Word Processing Software	3.5	3.4
2	1	4	Use Data Base Management Software	3.6	3.3
3	6	3	Use Spreadsheet Software	3.7	3.6
3	0	0	Use Communication Software	3.1	2.9
			Other Topics - Please List:		

COMMENTS:

How Important: 1 = No Value
2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank			Business Economics	Averages	
3	2	1		How Important	How Often Used
2	2	6	Cost of Product	4.2	4.1
5	2	0	Inventory	4.1	4.1
1	1	11	Profit/Loss	4.2	4.0
1	3	1	Profit Margin	4.0	3.7
1	2	1	Cash Flow	3.8	3.6
3	2	3	Corporate Goals	4.0	3.5
1	1	0	Corporate Policies	3.9	3.6
1	1	1	Supply/Demand	3.7	3.4
2	0	3	Global Competition	3.1	2.8
5	2	1	Overhead/Fixed Costs	4.3	3.9

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How Important: 1 = No Value
2 = Little Value
3 = Useful
4 = Important
5 = Very Important

How Often Used: 1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Very Often

Rank			Business Economics	Averages	
3	2	1		How Important	How Often Used
0	1	1	Workman's Compensation	4.0	3.4
0	0	0	Community/Civic Responsibility	3.5	3.1
2	1	2	Union/Management Relations	3.5	3.5
1	0	0	Customer Service - Warranty		
3	8	0	Repair, Satisfaction, Parts	4.2	4.0
5	3	16	Customer Satisfaction	4.7	4.6
4	3	0	Product Liability	4.0	3.6
			Other Topics - Please List:		

COMMENTS:

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ILLINOIS STATE BOARD OF EDUCATION

100 North First Street • Springfield, Illinois 62777-0001

Thomas Lay Burroughs
Chairman

Robert Leininger
Interim State Superintendent

May 17, 1989

Dear :

Recently you received a letter dated May 1, 1989. It contained a survey which we need in order to develop a quality manufacturing curriculum which would be responsive to your needs as potential employers. The letter should have contained a self-addressed envelope in which you were to return this survey. We have reason to believe the envelope was inadvertently omitted.

We are enclosing a new survey and envelope. If you have already returned the survey, please disregard this letter. If you have not, please take a minute to respond. In order to be valid, it is important we have a good return rate. Your response by May 26, 1989 would be appreciated.

We apologize if our error has caused you any inconvenience. Your assistance in this matter is greatly appreciated. Should you have questions, please contact me at 217/782-4620.

Sincerely,

Jerry Ohare

Jerry Ohare
Contract Administrator
Vocational Education Program Improvement

An Equal Opportunity/Affirmative Action Employer

Manufacturing Curriculum

Questionnaire

Name of Firm: _____

Address: _____

_____

This Questionnaire was completed by: _____

Position of person completing questionnaire: _____

What is the minimum education level for entry employment at your firm?

How many entry level people do you hire per year?

What percent of your employee training is done on the job?

Directions

On each of the following pages there are lists of topics related the field of Manufacturing Technology. Please rate each topic as it applies to your business.

Please rank the 5 most important topics on each page. Just put a "1" next to the most important topic and proceed until you have ranked the top 5. The rank column is on the left of each page.

If you feel that some topic has been omitted, feel free to add it at the bottom of the page under "other". There is also a place for any comments you wish to make. Your comments and your ranking are important. We will use this data to improve our manufacturing curriculum.

RANK	Technical Concepts	HOW IMPORTANT No Value 1	Little Value 2	Useful 3	Important 4	Very Important 5		HOW OFTEN USED Never 1	Seldom 2	Occasionally 3	Often 4	Very Often 5
	Linear Measurement											
	Precision Measurement											
	Blueprint Reading											
	Inventory Control - Manual & Automated - Including JIT											
	Quality Control - Manual & Automated - Including SPC											
	Manufacturing Concepts											
	Cellular/Group Technology											
	Automation/Electronic Control											
	Research & Development											
	Product Design											
	Simulation											
	Product & Process Control											
	Plant Layout											
	Product Packaging											
	Product Distribution											
	Understand the CADD/CAM Link											
	Safe Work Practices & Attitudes											
	Other Topics - Please List:											

COMMENTS:

RANK	Employability & Interpersonal Skills	HOW IMPORTANT: No Value 1	Little Value 2	Useful 3	Important 4	Very Important 5		HOW OFTEN USED: Never 1	Seldom 2	Occasionally 3	Often 4	Very Often 5
	Teamwork - Group Process, Team Building & Interaction											
	Decision Making - Effective Reasoning											
	Creative/Innovative Problem Solving											
	Understanding Social, Cultural, & Language Differences											
	Workplace Ethics											
	Community Involvement - Giving Something Back to the Community											
	Adaptability/Coping with Change											
	Communication											
	Written											
	Oral											
	Listening											
	Procuring a Job											
	Advancing on the Job											
	Understanding the Corporate Structure											
	Other Topics - Please List:											

COMMENTS:

		HOW IMPORTANT						HOW OFTEN USED					
		No Value	Little Value	Useful	Important	Very Important		Never	Seldom	Occasionally	Often	Very Often	
RANK	Computer Literacy	1	2	3	4	5		1	2	3	4	5	
	Using the Operating System ie MS/DOS												
	Keyboard Skills												
	Traditional Typing Keyboard												
	Specialty Keyboard - Function Keys & Numeric Pad												
	USE Word Processing Software												
	USE Date Base Management Software												
	USE Spreadsheet Software												
	USE Communication Software												
	Other Topics - Please List:												

COMMENTS:

		HOW IMPORTANT						HOW OFTEN USE					
		No Value	Little Value	Useful	Important	Very Important		Never	Seldom	Occasionally	Often	Very Often	
RANK	Business Economics	1	2	3	4	5		1	2	3	4	5	
	Cost of Product												
	Inventory												
	Profit/Loss												
	Profit Margin												
	Cash Flow												
	Corporate Goals												
	Corporate Policies												
	Supply/Demand												
	Global Competition												
	Overhead/Fixed Costs												
	Workman's Compensation												
	Community/Civic Responsibility												
	Union/Management Relations												
	Customer Service - Warranty												
	Repair, Satisfaction, Parts												
	Customer Satisfaction												
	Product Liability												
	Other Topics - Please List:												

COMMENTS:

APPENDIX D

MANUFACTURING CURRICULUM ACTIVITY PLAN FORMAT

Description

Where are you going?
How are you going to get there?
Brief overview of activity.

Rationale

Justification - Why?

Use real-world application examples.

Objectives

Use measurable verbs - active statements.

Tools, Materials, Machines

Resources needed:

Bibliography (books, journals, etc. - identify titles, authors, and publishers).

Software (identify titles, authors, and publishers). Consider accessibility, cost, and quality.

Safe Practices

State most obvious and necessary safety concerns.

Technical Activities ("group" and individual)

Student information sheet
Visuals
Examples of sketches, diagrams, etc. for items such as: plant layout, jigs/figures
Student work or lab sheets

Alternative Strategy:

Suggest 1-3 alternative ways to accomplish objectives in a minimally required environment using brief format.

Learning Check:

Written questions with answers.

Performance Check:

Suggest practical observation performance(s).

Integrative Skills

Communication:

___Reading
___Writing
___Speaking
___Listening

Computation:

___Fractions
___Decimals
___Percents

Personnel: *See App. Work Behavior - Attitudes/Behavior

Teamwork (Interpersonal): Business

___Assertiveness
___Negotiation
___Listening
___Risk Taking

Change:

___Personal Adaptation
___Professional Adaptation

Computer:

___Operating Systems
___Keyboards
___Applications_____

Decision Making:

___Ethical Reasoning
___Logical Reasoning
___Flexibility

Problem Analysis:

___Identification
___Solutions
___Evaluation
___Implementation